

## ***Interactive comment on “Representing northern peatland microtopography and hydrology within the Community Land Model” by X. Shi et al.***

### **Anonymous Referee #1**

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This is an interesting study of water table dynamics at a single peatland site, particularly as it deals with microtopography, but is limited in scope. Its contribution to our understanding of peatland hydrology would be improved if the robustness and generality of model parameters were better established to assure us that they are of general application in peats with diverse hydrological characteristics that do not require site-specific parameterization. Its contribution would be further improved with more information about, and testing of, water movement above the water table and transfer to the atmosphere.

Introduction p. 3383 l. 16: Grant et al. (2012) modelled, rather than reported, that the productivity of wetlands was strongly affected by changes in water table level. p. 3385 l. 17: ...used ...

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Model Description p. 3389 eq. (1): The physical basis for this equation needs to be presented – what hydrological process or soil attribute does  $f_{\text{drai}}$  represent? Is the value used here applicable only to the peat in this study? How can it be derived for peats with differing hydrological characteristics without recalibration? The term ‘z<sub>lagg</sub>’ in this equation is the same as the external water table used to define boundary hydrology in Grant et al. (2012), and so does not represent a conceptual advance on earlier modelling approaches as claimed on pp. 3384 – 3385 in the Introduction, but rather a similar approach. p. 3389 l. 16: mm s<sup>-1</sup> or kg m<sup>-2</sup> s<sup>-1</sup>? p. 3390 eq. (3): Again, the physical basis for this equation needs to be presented – what is the rationale for these terms? How robust are they? p. 3390 l. 23: How did 2013 differ from 2011 and 2012, thereby providing an independent test of the robustness of the modifications? It more convincing to test with results from more than one year.

## Results

p. 3393 l. 10: What was the lagg depth with respect to the hollow?

p. 3395 l. 25: Under higher temperature, wouldn't soil surface drying with lower water table (Fig. 6) reduce surface evaporation from soil (Table 2: Fig. 7) and moss during summers through reduced soil hydraulic conductivity? Information about modelled water movement in the unsaturated zone is not provided in the paper. Tests of modelled soil water content above the water table should have been included in order more fully to evaluate the model.

Also air temperatures greater than ca. 20 °C are commonly observed not to raise LE measured by eddy covariance towers over coniferous forests because of decreased stomatal conductance. This response has been modelled with a D0 term in the Ball-Berry equation, although it can be better attributed to lower hydraulic conductivity in coniferous xylem. This response may be less apparent in larch than in spruce. However it does suggest a smaller increase in  $E_c$  and hence ET (Fig. 7), and hence a smaller increase in water table depth (Fig. 6), than that modelled here. Information

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about the calculation of ET in CLM in this paper is inadequate to evaluate model results for ET (e.g. the D0 term was left out of Table 1). How were these issues of LE response to temperature addressed in the model, and was the response of modelled LE to temperature evaluated against flux measurements?

#### Discussion

p. 3398 l. 17: The zlagg term in Eq. 1 does in fact, represent a local constraint to lateral boundary flow in the model. There is nothing wrong in having such a constraint, but it is not accurate to indicate that this constraint is absent.

p. 3398. Sec. 5.2: Discuss site-specificity of the fitted parameters in Table 1. How robust are they? To what extent do they reflect the varying hydrological characteristics of different peats?

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